

Application No. 10/078,344
Reply to Office Action of August 8, 2003.

REMARKS

Favorable reconsideration of this application as presently amended and in light of the following discussion is respectfully requested.

Claims 1-3, 5-7, 9 and 26 are pending in the present application. Claim 4 has been canceled, Claims 1, 3, 6 and 9 have been amended and Claim 26 has been added by the present amendment.

In the outstanding Office Action, Claims 1, 3, 4 and 6 were rejected under 35 U.S.C. § 103(a) as unpatentable over Disney; and Claim 9 was indicated as allowable if rewritten in independent form.

Applicants thank the Examiner for the indication of allowable subject matter. In light of this indication, new Claim 26 has been added and is similar to dependent Claim 9 rewritten in independent form.

Claims 1, 3, 4 and 6 stand rejected under 35 U.S.C. § 103(a) as unpatentable over Disney. This rejection is respectfully traversed.

Amended Claim 1 is directed to a semiconductor device including a supporting substrate having a first region and a second region. The second region of the supporting substrate has a surface lower than a surface of the first region of the supporting substrate. Also included is a buried oxide layer formed above the first region of the supporting substrate, a semiconductor layer formed above the buried oxide layer, and an epitaxial layer formed above the second region of the supporting substrate. Further, an interface between the epitaxial layer and the supporting substrate is set in a portion which lies deeper than the buried oxide layer.

Application No. 10/078,344
Reply to Office Action of August 8, 2003.

In a nonlimiting example, Figure 4 illustrates a semiconductor device including a supporting substrate 31 comprising a first region (SOI region) and a second region (bulk region) in which the second region (bulk region) of the supporting substrate 31 has a surface lower than a surface of the first region (SOI region) of the supporting substrate 31. Also shown is a buried oxide layer 32 formed above the first region of the supporting substrate 31, a semiconductor layer 33 formed above the buried oxide layer 32, and an epitaxial layer 34 formed above the second region of the supporting substrate 31.

According to the claimed invention, the supporting substrate is located below the SOI region (a first region) and an epitaxial layer 34 is not formed below the buried oxide (box) layer 32 in the first region. This differs from Disney. That is, Disney discloses a structure in which a buffer layer 20 and an epitaxial layer 24 are formed above a supporting substrate (silicon substrate 20), and an SOI region (buried oxide layer 18 and SOI wafer 16) is formed above the epitaxial layer 24.

With the structure of Disney, where an n-type impurity diffusion region (an epitaxial layer) is formed below an SOI region, an electrical field that is generated by an element (vertical IGBT device) 10 will permeate through the n-type impurity diffusion region and spread below the SOI region when the element 10 is put into operation. The electric field causes a control circuitry 12 to malfunction if a buried oxide layer 18 is not sufficiently thick or provides no improved insulation characteristics.

According to the claimed invention, a bottom portion of the SOI region is a supporting substrate (for example, a silicon substrate with a dopant density of approximately 1×10^{16} atoms/cm³). Thus, an electric field will have less effect on the bottom portion of the SOI region. Therefore, even if an insulating film 18 were thin, an element formed in the SOI

Application No. 10/078,344

Reply to Office Action of August 8, 2003.

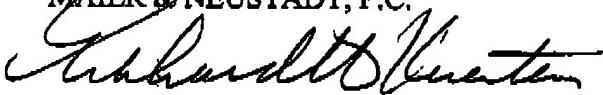
region will not malfunction. In other words, electrical isolation between the SOI region (a first region) and the bulk region (a second region) becomes reliable by forming an epitaxial layer above the bulk region (the second region), and not forming an epitaxial layer below the SOI region (the first region).

Accordingly, it is respectfully independent Claim 1 and each of the claims depending therefrom are also allowable.

Consequently, in light of the above discussion and in view of the present amendment, the present application is believed to be in condition for allowance and an early and favorable action to that effect is respectfully requested.

Respectfully submitted,

OBLON, SPIVAK, McCLELLAND,
MAIER & NEUSTADT, P.C.



Customer Number

22850

Eckhard H. Kuesters
Attorney of Record
Registration No. 28,870
David A. Bilodeau
Registration No. 42,325

EHK/DAB/rac

I:\ATTY\IDAB\V219723US-AM.DOC